As a measure to prevent nausea and vomiting under anæsthesia we wish to lay stress on the importance of administering the anæsthetic gradually and maintaining the anæsthesia in a uniform degree. Any surprise to the centres, or sudden alteration of their molecular or nutritive changes, may cause nausea. An hypodermatic injection of the sulphate of morphia occasionally has this effect. So, anæsthetics, or other agents acting similarly, when administered interruptedly, act unevenly on the centres, and by such repeated surprises cause nausea. They act like a rough sea.

Chloroform and ether, therefore, have their respective fields of usefulness, in which they are equally serviceable. They are equally dangerous when given in the face of their contraindications. Not until medical men learn to discriminate properly in their choice of these anæsthetics, and recognize the fact that the dangers of general anæsthesia depend as much on the method of administration as on the toxical property of the agent employed, will the risk of fatal accidents ever be reduced to the minimum."

ON THE SUTURE OF NERVES.

An elaborate article on the subject of the "Suture of Nerves" appears from the pen of Dr. Reclus, Agregé de la Faculté de Paris, in *Le Bulletin Medicale*, June 5, 1887, in which the subject is discussed from a physiological standpoint. As the subject is one of the living topics of the day a very full abstract of this paper is subjoined. In connection with this paper, the student will do well to refer to the editorial notices of many recent contributions to this subject to be found in the ANNALS OF SURGERY, Vol. I, p. 132, 1885, and to the paper by Markoe, in Vol. II, p. 181, 1885.

Reclus begins by calling attention to the great obscurity which still hovers over the anatomical and functional changes which a nerve undergoes after section, suture and union. In spite of twenty years of patient observations and researches, experimental physiology and practical surgery have not been able to come in accord. If we are badly enlightended as to the why and the werefore of our successes, these are at least so brilliant that at this period primary and secondary suture are imposed upon us.

The work of Waller, Vulpian, Ranvier and Tripier on the regeneration of nerves is known. When a nerve trunk has been divided, at the end of a time, varying according to the species of animal—about the fourth or fifth day in man—the peripheral segment loses its properties, it becomes inexcitable, and histological examination gives us the key to this decline. The cells attached to Schwann's sheath swell up, surround themselves with protoplasm, and become hollowed at the expense of the myeline. The protoplasm still grows, attacks the axis cylinder, at first injured and then cut through, and the essential element of the nerve is thus destroyed in the whole extent of the peripheral end. This destruction of the axis cylinder is the chief thing, and the subsequent changes are of less importance. The segmented axial filament united with the masses of myeline soon disappears before the proliferation of the cells, whose nuclei keep dividing. So that on the twentieth day the nerve fibre is only a sheath of Schwann filled with protoplasm and nuclei. Again these elements atrophy, tend to disappear gradually, and finally the sheaths are lost in the midst of the interstitial fibrous tissue.

The central fragment, which remains in connection with the nervous axis, also undergoes important modifications; but instead of being attacked in its whole length, only the extremities of the fibres are altered, the lesions never passing beyond the first annular constriction above the section. In this short piece, the cells proliferate and the myeline is broken up. Here the destructive processes respect the axis cylinder, which becomes, on the contrary, the seat of a special formative activity, to which is due the phenomena of nerve regeneration, commencing about the twentieth day. At the level of the constriction each axis cylinder buds out and gives birth to one, or sometimes to three fibres, covered with myeline, and formed of very short inter-annular segments; these fibres traverse the sheath of Schwann, in the middle of the nuclei and protoplasm, and reach the peripheral fragment. The axis cylinder may be naked, and it is not until after the first bifurcation that it becomes surrounded with myeline. Thanks to the successive ramifications, a single axis-cylinder gives rise to thirty or forty new ones; so that the number which go to regenerate the distal fragment is very considerable. When the two divided ends are in contact or very near, the axis cylinders of the upper segment have only a short space to traverse in order to reach the lower. If the distance is much greater the two extremities cicatrize independently; the solution of continuity persists, and the isolated lower end is not regenerated; but the interval must then be 5 to 10 centimetres or more, otherwise the young axis cylinders of the proximal segment advance through the fibrous, cicatricial tissue formed between the two ends, thus reaching the distal segment, in which the collapsed sheaths of Schwann contain only a few refracting masses—the remains of the old myeline—a little protoplasm and some nuclei. Now these sheaths receive a greater or less number of the new axis-cylinders, very slender no doubt, but completely formed. According to Mr. Renant they are not contained in Schwann's sheath; sometimes they are placed outside, and roll themselves around like a sprig of a wild vine about a tree trunk, and sometimes they are quite free, forming either straight bundles, in which the fibres often cross one another in a Y-shaped manner, or an interwoven net work.

The nerve is henceforth regenerated; the new fibres can transmit to the muscles excitations of the centres, and can conduct to the centres peripheral impressions. Demonstration of this fact is now beyond doubt, and, when the animals are young, if the section of the nerve has been performed with proper precautions, the essential properties of the nerve are re-established after a variable time. This is what physiology teaches us, and the hope which it allows us to entertain. Does the practice of the surgeons realize them in man?

An old observation of Béclard, a case of Pajot dated in 1853, and that of Tangier in 1864, seemed to plead in favor of nerve regeneration in man. Moreover, the utility of suture was believed in until 1867, when a fact of Richet came to compromise the theory; in a complete section of the median, that surgeon examined the sensibility before suture, and found not without surprise, that it persisted in nearly the whole extent of the territory supplied by the divided nerve. Explanations were sought, and Richet, and afterwards Tripier, showed that the phenomenon was due to recurrent sensibility.

These authors have proved that, in the upper limb, sensibility persists, enfeebled no doubt, but beyond question, in the parts animated by a sectioned nerve. This retention of sensibility is owing "to the recurrent fibres which the different nerves usually send forth." The anastomoses take place in the region of the terminal plexuses, near the skin or in its substance ; they ascend along the different tissues, and are lost later on. After the diarœsis these fibres remain intact in the peripheral segment, while the direct fibres—those of the nerve itself—degenerate. It is to the former that we owe the persistency of sensibility, since it is these which are unaltered, This theory, besides being unassailable, and which alone could explain numerous observations similar to that of Richet, soon became the exclusive one; retained sensibility replaced recovered sensibility, and regeneration was considered by a number ot surgeons only as a feature of young animals. It lost all credit in human pathology. and in 1883, Richelot declared at the "Société de Chirurgie," that suture was incapable of producing regeneration in a nerve; the nervous current could not traverse the cicatrix. If sensibility persist it was thanks to collateral paths, and as the analogous paths "are wanting almost completely in motor filaments, movement never reappeared; in those altogether exceptional cases in which it appeared, we must put it down to certain anastomoses, the existence of which is far from being constant."

At the time when Richelot wrote this report, a mass of observations were accumulating which put in evidence the reality of nerve regeneration in man. Page, Braussold, Th. Kölliker, Boegehold, Tillmans and Polaillon, had published the proving facts, and Chaput, in the following year gave us a résumé of sixty-six cases in which nerve suture had been performed with success in two-thirds of the cases. But in these observations the facts are different, the conditions so diverse and the results so often unforeseen and so incomparable that it is necessary to divide them into a certain number of categories, each to be studied by itself.

The cases where, after suture of mixed nerves—at the same time sensitive and motor—such as the median, the radial and the ulnar, sensibility alone returned, should first be eliminated because it is very difficult in these cases to distinguish between retained or recurrent, and regained sensibility. There is often only a difference varying according to the time, or even depending upon the æsthesiometer, and which may not be appreciated; for as much as the initial anæsthesia may cause a passing disturbance, local stupor, or even certain hysterical troubles.

In the present state of science we cannot explain immediate return of sensibility, after placing in-contact divided nerve segments, as in the following hitherto unpublished case, reported to the author by his friend, Dr. Paul Segond:

A seamstress, æt. 25, entered at the Hospital Beaujon at 10 o'clock in the morning; two hours before she had fallen on a staircase, and a fragment of a milk jug divided, above the wrist, the greater part of the anterior tendons, the ulnar artery and nerve, and the median nerve. MM. Segond and Rémy examined the sensibility; anæsthesia was complete over the whole region supplied by the two divided nerves. The prick of a needle, and contact of a red-hot stylet, were not felt, and while pinching the upper or central segment of the nerve caused acute pain, vigorous pressure of the lower or peripheral end exhibited none. Suture was at once performed without anæsthetics. As soon as the two ends of each nerve were faced together, tickling could be felt over almost the whole extent of integument innervated by the median and ulnar; ten minutes afterwards the contact of a red-hot stylet or a pin was painful. Thenceforth, sensibility, proved by Weber's compass, seemed to be perfect. Unfortunately, the muscles remained paralyzed and their atrophy persists.

Numerous cases are on record in which, after the suture of divided nerves sensibility and movement have reappeared after a longer or shorter interval, and in which the effect of "recurrence" cannot be invoked as the cause. These are divisible into two groups. The first includes those in which the functions have not been re-established until a considerable time after suture—several weeks or months may intervene from the time when the two ends have been placed in contact. These facts are in accord with physiology, and confirm the assertions of experimenters. The second group comprises the cases where sensibility and motor power have returned so rapidly that one would be tempted to doubt the observations, were it not for their number and for the worth of the surgeons who have published them. The observations of the first class, which we shall call "physiological," in contradistinction to the second or "paradoxical" cases, are not rare. That of Chrétien, of Nancy, will serve as a type. A boy, æt. 18 years, cut the median nerve with a fragment of a bottle; sensibility of the palmar surface of the fingers by the nerve has completely disappeared, the muscles of the thenar prominence are paralyzed, and opposition of the thumb impossible; the short abductor, the opponens, and the short flexor are inert. Suture of the nerve is performed; the wound heals without difficulty, and little by little sensibility and movement return. In fact, at the end of two months and a half the patient can already execute opposing movements; the muscles of the thenar eminence contract under the influence of the will; and four months later the use of the hand is easy enough. Finally, eighteen months after the operation, Chrétien again saw the patient; the thenar muscles can be nicely felt when they contract; there is no appearance of atrophy, and Prof. Beaunis, with the help of the most precise methods of physiology, establishes that sensibility and movement are about the same on the wounded as on the healthy side, and in this case it could not be put down to the anastomosis of the ulnar and the median, for besides that, immediately after the section, paralysis of the opposing muscles was well marked, it was observed that, when the movements were re-established, excitation of the median above the cicatrix produced contraction of the muscular mass. Moreover, we must be allowed to think that the motor current followed the normal path of the median nerve, and Chrétien seems to us correct in concluding "that union by suture of the two ends of a divided nerve, may even in man lead to the re-establishment of the motor and sensitive functions of the nerve."

The essay of Marciquez furnishes us with a dozen analogous observations. Cure has not always been so complete, but the patients have often been older, the separation of the ends much greater, or the section of the nerve very high up, leaving a very extensive lower segment requiring a longer time for regeneration. In general, at the fifth or sixth month, under the most favorable conditions, movement has reappeared in the atrophied and paralyzed muscles. There is nothing in it abnormal, and, we repeat, the facts accord with our physiological knowledge of the regeneration of nerves.

Of the second group, or "paradoxical" cases, two facts of Tillaux may be cited as characteristic: A young girl, æt. 23 years, cut her median nerve; four months after the wound it is proved that there is insensibility of the palmar surface of the thumb, the index and the middle finger, of a part of the palm, and of the dorsal surface of the last phalanges of the index and middle fingers; anæsthesia is less marked, although very manifest on the external half of the ring finger. The muscles of the thenar eminence are atrophied, and the opposing movements of the thumb are abolished; trophic lesions exist on the middle and index fingers. The patient urgently entreated operation; the two ends of the median were exposed, and were distant from each other about 1 centimetre; the central end was swollen, while the peripheral was tapering. They were cleansed, and with a needle threaded with Florence gut, brought together and exactly adjusted; the thread was cut close to the knot and left in the wound. The most minute antiseptic precautions were taken, and the hand kept immovable. From the second day the patient complained of tingling on the palmar surface of the index and middle finger; on the third she perceived the contact of a pin, and even improvement in the movements. Six weeks after the intervention, movement and sensibility had so far returned that she could work at crochet and with the needle.

The second operation, performed on a woman æt. 28 years, is, so to speak, exactly superposable on the first, the only notable difference being that the section of the median dated from fourteen years before. But in the two cases the same impotence is observed, and the same appearances are found in the two ends; the revivifying and the suture were performed in the same manner, and the result in both cases was identical. From the next day the fingers became sensitive and mobility reappeared. Moreover, in the second as in the first, the results were not ephemeral. Since leaving the hospital the two patients have not only retained the benefits of the surgical interference, but have seen them increase.

These two cases are not isolated. Three years before Tillaux' communication, Kraussold, then Th. Kölliker, then Boegehold, then Tillmanns, had published observations on suture, the first of all the nerves of the wrist, the second of the median and ulnar, the third of the radial, and the last of the ulnar. On the 2d day, the 8th, the 14th, and the 28th, they respectively saw return of sensibility and mobility. In a recent case of Polaillon, sensation manifested itself at the fifth hour.

The observation of Segond, where the disappearance of anæsthesia was immediate, has already been referred to. It will be seen that cases of almost immediate functional recovery are already very frequent.

These facts clash with what is known concerning the regeneration of nerves. Whether the suture has been primary or secondary, the immediate or rapid reappearance of sensation and motion cannot be explained. When the suture is primary, *i. e.*, performed a few hours after the wound, in any case before the end of the fourth or fifth day—the time when the axis-cylinders of the peripheral end are already destroyed—the return of the functions would necessitate the immediate union of the two segments. This immediate union has been well observed, but to this hour physiologists affirm that only the fibrous elements of the nerve-cord then adhere; the axis-cylinder, the essential agent of conductibility never joins directly to another cut axis-cylinder and the continuity of the nerve can only be re-established by the slow and complicated mechanism of degeneration, such as we have already described.

Immediate union, anatomically and functionally established, by newly formed nervous elements interposed between the still living two segments of the divided nerve, has been affirmed by Gluck and by Bakowiecki, but their experiments have appeared less than decisive to

Hehn, Falkenheim, Johnson, Ranvier and Vulpian. This immediate union, not only questioned but also rejected, should it be admitted, would only explain a very few of the cases of nerve suture in man. Since in the thirty-nine cases of primary suture, abstracted by Chaput, there are only four of immediate re-union. Moreover, Chaput only considered them as probable, whilst in twenty-seven secondary sutures, there were seven "certain" immediate unions.

Successes of secondary suture—of the two ends separately cicatrized—are still more paradoxical than after primary suture.

Because, however, the explanation of a fact is wanting, the fact itself is not invalidated. The rapid or immediate re-establishment of nerve functions has been observed too often, and by surgeons of too much weight, to question it. For practitioners the rule of conduct is quite settled that, when a nerve has been divided its two ends must be approached and maintained in contact by a delicate suture of catgut or Florence gut. Every precaution must be taken to avoid suppuration, since it promotes the formation of fibrous tissue and nodular masses, which compress the cicatrix and affect the functions of the nerve.

A certain number of cases have been reported in which nerve suture having appeared to give a negative result, a fresh incision has been made in order to revivify it and to attempt a more fortunate union, and in which it has been found after disengaging the nerve trunk from the surrounding fibrous tissue, that the continuity of the nerve has been perfect. No further interference being done, by degrees the functions have been observed to reappear. Ehrmann described a very clear case to the Société de Chirurgie. A cut radial was sutured seven months after the accident. Paralysis persisted; seven months later the nerve was laid bare, the nodular tissue excised, and it was ascertained that the continuity of the nerve trunk was established. At the end of a few days mobility returned in the paralyzed muscles.

The first practical conclusion reached by the author is that in cases of divided nerve-trunks primary suture should be done, and if it fail that a secondary operation be done, which will have a great chance of being followed by success. If the loss of substance of the nerve is so great that the two segments cannot be brought into apposition by altering the position of limb, or by traction on the threads, "suture at a distance" must be performed, which as the experiments of Assaky have shown, diminishes the interval which separates the two ends of the divided nerve. By this means, at least in animals, the nervous cicatrix developed along the threads of suture, is richer in nerve fibres of new formation than when we abandon the cure solely to nature.

P. S. ABRAHAM.

HEATH ON CERTAIN DISEASES OF THE JAWS.[1]

Mr. Heath's lectures bear the impress of the many years of study and the careful clinical observation which he has directed to this department of surgery. The subject matter had already been published in a more extended manner in his well-known work on Injuries and Diseases of the Jaws (London, 1884); nevertheless, the concise and readable form in which he has embodied it in his lectures will be welcomed by many who are unfamilar with the larger treatise; and to those who were privileged to hear them the lectures were rendered extremely interesting and instructive by the large number of specimens with which they were illustrated. These comprised not only specimens from the large and complete series in the Royal College of Surgeons' Museum, but in addition many valuable and unique specimens culled from the museums of most of the London hospitals. Mr. Heath commences with a description of the anatomy of the antrum and of the diseases implicating that cavity. He gives rules for diagnosis between suppuration in the antrum and ozeona—sometimes confounded. In suppuration in the antrum there is occasional purulent discharge determined by position of the head, an offensive smell perceptible only to the patient and not to his friends, together with dull aching and often neuralgic pain. The neuralgia sometimes takes the

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[1] Lectures on Certain Diseases of the Jaws. Delivered at the Royal College of Surgeons of England, June, 1887. By CHRISTOPHER HEATH, F. R. C. S., Hunterian, Professor of Surgery and Pathology. *Brit. Med. Jour.*, June 11 to July 16, 1887.